TRINITY TO TRINITY

The journey from Trinity to Trinity begins with the New Mexico desert night sky turning instantly to day at 05:29 am on July 16, 1945. An eyewitness recalled,

"The effects could well be called unprecedented, magnificent, beautiful, stupendous, and terrifying. The lighting effects beggared description. The whole country was lighted by a searing light with the intensity many times that of the midday sun. It was golden, purple, violet, gray, and blue."

It was the Trinity Test: the world's first nuclear detonation.

This year, the Laboratory is marking the 70th anniversary of the Trinity Test because it not only ushered in the Nuclear Age, but with it the origin of today's advanced supercomputing—the Age of Supercomputers largely began with weapons science at Los Alamos.

The evolution of computers is directly tied to the evolution of nuclear weapons. Simple computers were key to the design and development of the first nuclear bombs, like the one detonated during the Trinity Test. Throughout the Cold War, ever more powerful computers were designed and built specifically to aid the design and build cycle that led to today's U.S. nuclear deterrent.

Just as it was 70 years ago, the key mission of Los Alamos is to provide the nation with a safe, secure, and effective nuclear deterrent. From 1945 to 1992 the Lab designed, tested, and built many different types of weapons. Today, the Lab uses its science and engineering capabilities to ensure that the few thousand weapons that remain in the deterrent are safe, secure, and effective.

The weapons in the stockpile are built of thousands of components; some of these components are now beyond their expected lifespan. These aging components must be continuously evaluated, replaced, repaired, or redesigned—and then tested where possible, and the findings reported to the President of the United States.

Without supercomputing this would not be possible. This brings the journey to the new Trinity supercomputer. At 40 petaflops (40 quadrillion [10^{15}] floating point operations per second) and with 2 petabytes of memory, Trinity will be the second or third fastest computer in the world.

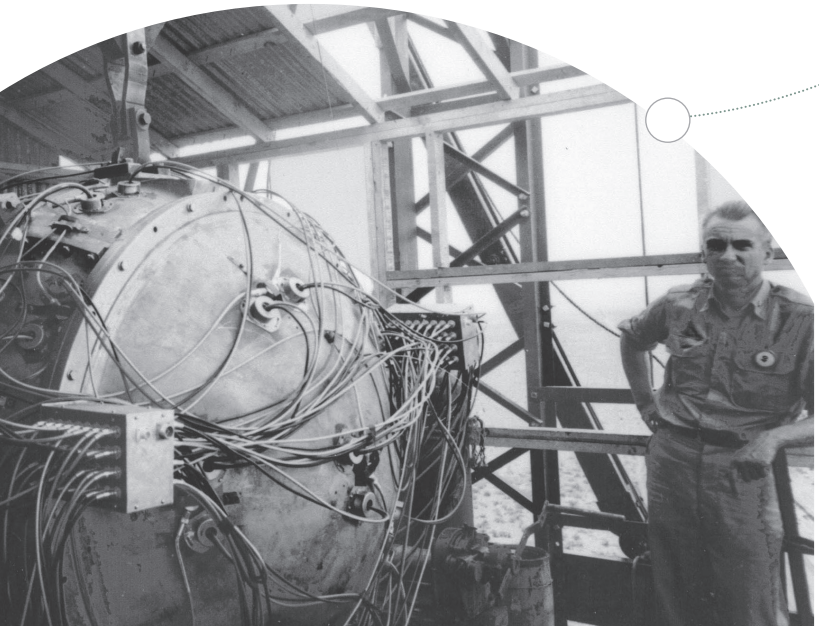
But its speed is not as significant as what it will do with its speed *and* revolutionary new programming; Trinity will make complex, 3D simulations of nuclear detonations practical with increased fidelity and resolution.

Highly accurate 3D computing is a Holy Grail of the Stockpile Stewardship Program's supercomputing efforts. As the weapons age, issues may arise that require highly accurate 3D modeling to understand and resolve. This is a great challenge reminiscent of the one faced by the Manhattan Project: building the first nuclear weapon that works. Now our challenge is to understand how and why a weapon works well enough to confidently predict its performance without requiring an additional nuclear test.

The Trinity Test of 1945 was the first full-scale, real-world test of a nuclear weapon; with the new Trinity supercomputer our goal is to do this virtually, in 3D.

Because stewarding these weapons depends on an in-depth understanding of mind-bogglingly complicated physics, which we are still unraveling, and because warhead components continue to age—and thus change their characteristics—there is no foreseeable end to the challenges of stockpile stewardship. Highly accurate 3D computing is a critical part of this journey, but not its destination.

~Clay Dillingham



Norris Bradbury, who became the Laboratory's second director, stands beside the Gadget just hours before the Trinity Test. Above: A supercomputer simulation. (Photos: Los Alamos)